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ABSTRACT

This study investigated the effect of informational, drill, and game format computer-assisted instruction (CAI) on the achievement, retention, and attitude toward instruction of sixth-grade science students (N=37). An informational CAI lesson on Halley's Comet was administered to three randomly selected groups of sixth-grade students. A CAI drill about the content of the informational lesson was given to one group, and a CAI game was given to another group; only the informational lesson was presented to the third group. No significant differences were found between the groups on a posttest measuring achievement given immediately after the instruction or on a retention posttest given one month later. Students in the group receiving the CAI game did differ significantly from the other groups in their attitude about how much they had learned from the lesson. (IAH)

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Drills vs. Games - Any Differences?

A Pilot Study

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Abstract

This study investigated the effect of informational, drill, and game format computer-assisted instruction (CAI) on the achievement, retention and attitude toward instruction of sixth grade science students. An informational CAI lesson on Halley's Comet was administered to three randomly selected groups of sixth grade students. a CAI drill about the content of the informational lesson was given to one group, a CAI game was given to another group, and one group received only the informational lesson. No significant differences were found between the groups on a posttest measuring achievement given immediately after the instruction or on a retention posttest given one month later. Students in the group receiving the CAI game did differ significantly from the other groups in their attitude about how much they learned from the lesson.

Drills vs. Games - Any Differences?
A Pilot Study

Microcomputers are becoming commonplace in science classrooms - so the question is not whether to use them, but how to use them to deliver instruction effectively. Computer programs exist which provide information, drill and practice, tutorial instruction, simulation of real-life situations and educational games. Each of these methods, while different in style and format, is capable of presenting the same content to students. Does the method of delivery have any effect on learning or attitudes of students toward instruction? The purpose of this study is to investigate the effects of informational, drill and practice and educational game format of CAI on achievement, retention and attitude.

In the 1970's, computers were seen as having vast potential for the teaching of science - especially in the areas of simulation, interactive instruction, and individualized study (Lunetta & Dyrli, 1970). Lipson (1983-1984) recommends the use of intelligent drill and practice programs in the science curriculum. Ellis (1984) advocates using educational games to motivate students to master basic science facts.

Numerous studies have compared the effectiveness of CAI with traditional instruction - instruction not involving the use of computers. Edwards et. al. (1975) reported that CAI instruction resulted in equal or higher achievement in a majority of studies. Zsiray (1983-84), reported that CAI was at least as effective as the lecture method and significantly more effective than independent reading. Kulik, Bangert and Williams (1983) concluded that students learning with CAI performed better than those learning by traditional methods.

The effectiveness of CAI drill and practice versus traditional instruction has been demonstrated in many studies. Vinsonhaler and Bass (1972) found that CAI was more effective than traditional instruction when standardized tests were used to measure performance. By applying the technique of meta-analysis to 35 studies Burns and Bozeman (1981) determined that drill and practice CAI was significantly more effective than traditional methods in mathematics instruction.

Kulik et al. (1983) also found that CAI drill and practice resulted in higher achievement. The results of research in this area tend to agree that students who use CAI drill and practice will obtain higher achievement scores than students who learn by traditional methods.

With the advent of video arcades and home computers, computer gaming has become very popular. The game format has been incorporated into educational programs by several software developers (Chaffin, Maxwell and Thompson, 1982). The research on instructional computer games is limited because the application of computer games to meaningful instruction is quite recent. In an early study on computer games, (Wing, 1967), found that games were at least as effective as conventional instruction. Significant gains in mathematics achievement among sixth grade students using computer games for instruction were reported by Morris (1983). On the other hand, Spivey (1985) found that there was no significant difference in achievement between groups of first graders who used computer games to learn addition and subtraction and those who did not.

Bright (1985), concluded that there was no significant effect attributable to using microcomputer math games among preservice elementary teachers. However, Bright's study did not directly compare computer games with non-computer games. Dunne (1984) reported that computer games were effective instructional tools, but that the degree of effectiveness depends upon matching the style of the game with the subject matter and type of students using the game.

Research on the effectiveness of CAI has shown that in most cases students who are taught with CAI achieve more than students who are taught by traditional methods. Therefore, the value of CAI has generally been proven, but little work has been done on making comparisons across types of CAI. By comparing one type of CAI against another, it is hoped that some insight about the effectiveness of each particular type of CAI may be determined. With this knowledge, the teacher will better be able to make decisions concerning which type of CAI to use in particular classroom settings.

Statement of the Problem

The purpose of this study was to compare the effectiveness of three types of CAI lessons (informational, drill or educational game) on achievement and retention on a unit of instruction about Halley's comet. The study also examined the effect that the type of CAI lesson had on student attitudes toward CAI.

Research Questions

This study is concerned with three questions. (1) Will students in the educational game group differ significantly in achievement than either the drill group or the informational group? (2) Will students in the educational game group differ significantly in retention than students in either the drill group or the informational group? (3) Will students in the educational game group differ significantly in their attitude toward learning than students in either the drill group or the informational group?

Rationale

The major difference between the groups will be in the method of CAI used to deliver the instruction.

The treatments might produce different achievement and attitude results because they vary on several characteristics including motivation, feedback, interaction and time on task as well as others. These factors may have different effects for each of the three groups.

The group receiving only the informational CAI will probably have little to motivate it. Students will be told to read the material. No rewards will be promised or given, therefore the only source of motivation will be in the fact that they will be participating in an experiment. Students in this group will receive no feedback on their progress. They will have no way of knowing that they are learning the material - only that they have finished it. Interaction with the material will also be at a minimum. Students will press the return key when they have finished reading and will be presented with the next page of text. They will not be allowed to go back to a previous page. Students will not be given any opportunity to practice what they have read in order to aid in retention of the material.

The amount of time spent on the task will probably be considerably less than the other two groups.

The motivational factor will be increased for the drill group by adding a drill after the informational lesson is read. Students will be motivated to get the correct answers to the questions, but feedback will be minimal as students will not be told whether or not their answer is correct. Interaction with the material will be increased due to the responses required during the drill. Because the drill will be given in addition to the informational lesson, the time spent on the task will most likely be longer.

Motivation will be maximized in the educational game group by the addition of an adventure-type game after the informational lesson. The game will probably be more motivating because of the goal and the graphics that will inform students of their progress toward the goal. The graphics will provide concrete feedback to students on the correctness of their answers. Because of the game element students should interact more with the material.

Students in this group will probably spend more time on the task than students in either of the other two groups.

In summary, the educational game group might obtain higher scores on both the posttest and the retention posttest and have a more positive attitude toward the lesson because of increased motivation, concrete positive feedback, greater interaction, practice and more time on task.

Operational Definitions of the Variables

The following variables will be examined in this study: achievement, retention, attitude toward the learning experience and type of CAI (informational, drill or educational game). Achievement will be measured by scores on a posttest administered immediately after the completion of the unit of instruction. Retention will be measured by scores on a similar posttest administered one month after the unit of instruction is completed. The attitude of the student toward the learning experience will consist of the results of a survey of student feelings toward the type of instruction they received.

The three types of CAI that will be used in this study are informational, drill and educational game. The informational lesson will present text on the video monitor one page at a time with the student deciding when to view the next page of text. The drill lesson will be made up of two parts. Part one will consist of the informational lesson. This will be followed by questions about the informational lesson presented one at a time in flashcard format requiring students to respond by selecting the letter of the correct answer. The educational game lesson will also consist of two parts. The first part will be the informational lesson. The second part will begin with a screen explaining the rules and goals of the adventure. Next, the students will be asked to answer a multiple choice question about the material in the informational lesson. A correct answer to the question will present the student with a high resolution graphics picture on the screen giving the student feedback on his/her position relative to the goal of the adventure.

Method

Subjects

There were 37 sixth grade students who participated in the study. These students came from two classrooms and comprised the entire sixth grade of the school. The students were randomly assigned to one of three treatment groups - 11 receiving the informational lesson, 13 receiving the drill lesson, and 9 receiving the educational game. Because of absences, four students were eliminated from the study.

Materials

The materials used in this study consisted of both hardware and software. The hardware consisted of 13 Apple II plus computers with at least one disk drive and monitor. The researcher-developed CAI lesson about Halley's Comet had three parts consisting of information, drill and practice, and an educational game which was previously described. The following researcher-developed paper and pencil test instruments were used: pretest, posttest, attitude survey and retention posttest.

Design and Procedures

The pretest-posttest-posttest control group design was used in this study. The control group was the group receiving the informational lesson only. The first experimental group received the informational lesson followed by a drill lesson. The second experimental group received the informational lesson followed by the educational game. Pretest, posttest and retention posttest data were analyzed using analysis of variance procedures (ANOVA) with alpha = .05.

On the day before the treatment, the two classroom teachers randomly assigned each student in their class a number from 1 to 37. This number was used to assign subjects to groups and facilitate data collection. Teachers then administered the pretest consisting of ten multiple choice questions.

Students in the informational lesson only group were brought into the room with the computers, read the directions and told to begin. When all students in this group had completed the informational lesson, they were given a written posttest and attitude survey.

Students in the drill group were brought into the classroom next. They were read the directions and told to begin the informational lesson. When all students in this group were finished, the informational lesson was removed from their computer and the drill lesson was booted. They were told to follow the directions on the screen and begin. When everyone was finished with the drill lesson, the posttest and attitude survey was administered.

Finally, students in the educational game group were brought into the classroom, read the directions and told to begin the informational lesson. When all students were finished, the informational lesson was removed from the disk drive and the educational game was booted up. The students were told to follow the directions on the screen and begin. The posttest and attitude survey were administered when the entire group was finished. One month after the completion of the treatment, the retention posttest was administered by the classroom teachers.

Results

The pretest means for the informational, drill and educational game groups were 3.18, 3.00, and 3.00, respectively. The standard deviations for the informational, drill and educational game groups were 1.60, 1.68 and 0.87, respectively. A one-way ANOVA done on the retest scores detected no significant differences among the groups (see Table 1). Because the groups were statistically equivalent, an analysis of variance was used to determine if there were any significant differences among the groups on the achievement and retention posttests.

Table 1

Pretest ANOVA Summary

Source	SS	df	MS	F
Between Groups	0.2424	2	0.1212	0.06
Within Groups	65.6363	30	2.1878	-

Note. F is not significant at the .05 alpha level.

The group receiving the educational game scored highest on the posttest with a mean of 5.56 and a standard deviation of 1.87. The group receiving the informational lesson only scored next highest with a mean of 5.45 and a standard deviation of 2.66. The drill group scored lowest with a mean of 5.0 and a standard deviation of 2.77. However, the results of the ANOVA on the posttest showed no significant differences among the groups (see Table 2).

Table 2

Posttest ANOVA Summary

Source	SS	df	MS	F
Between Groups	2.0202	2	1.0101	0.16
Within Groups	190.9494	30	6.3649	-

Note. F is not significant at the .05 alpha level.

The group receiving the informational lesson scored highest on the retention posttest with a mean score of 4.67 and a standard deviation of 1.94. The group which received the educational game, scored next highest with a mean of 4.50 and a standard deviation of 1.41. The drill group scored lowest on the retention posttest with a mean of 3.82 and a standard deviation of 1.54. The retention posttest data were then analyzed using a one-way ANOVA. Again, no significant differences among groups were evident. (see Table 3).

Table 3

Retention Posttest ANOVA Summary

Source	SS	df	MS	F
Between Groups	4.0779	2	2.0389	0.75
Within Groups	67.6363	25	2.7054	-

Note. F is not significant at the .05 alpha level.

An analysis of the attitude survey revealed a significant difference among the groups on the question, "I feel I have learned much about comets from this lesson". The educational game group had a significantly more positive response to this question than the information group (see Table 4).

Table 4

Attitude Survey Summary for Student Response to the Question: "I feel I have learned much about comets from this lesson".

Group	n	Mean	Standard Deviation
Informational	11	4.2727	.9045
Drill	12	3.8333	.5774
Game	10	4.8000	.4216

ANOVA Summary

Source	SS	df	MS	F
Between Groups	5.0969	2	2.5485	5.68
Within Groups	13.4485	30	0.4483	-

Note. F is significant at .05 alpha level. Game group is significantly different than drill group at .05 alpha level.

Discussion

The results of this study do not support the original hypotheses that the group receiving instruction with the educational game would score significantly higher on an achievement posttest and a retention posttest than the groups receiving instruction with an informational computer lesson or a drill and practice computer lesson. Some factors that may have contributed to these results are the sample size, the classroom arrangement and the instructional design of the computer program.

The sample size might have been too small to uncover any significant differences between the groups therefore the study should be repeated using larger group sizes. Some disruption of the normal routine of the students was caused because the entire experiment was conducted during one morning of a school day. Also, the students in the group receiving the educational game were forced to wait until the other two groups were finished to participate since the entire sixth grade was used.

Some weaknesses were discovered in the program itself that may have contributed to nonsignificant results. The readability level of the text was calculated to be high (11th grade level). The graphics were slow loading and static - possibly lowering motivation and increasing frustration for the game group. The drill was a flashcard style instead of an increasing ratio review format.

In conclusion, the results of this study provide no statistical evidence that computer games are more effective than either drills or informational type CAI programs in presenting identical content to students. There is statistical evidence that the students who received instruction with an educational game perceived themselves as learning more about the content of the lesson than students who received instruction with the informational lesson or with the drill lesson.

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